SE-015-005-1A

OFFICE OF MANNED SPACE FLIGHT

APOLLO PROGRAM

WEIGHT AND PERFORMANCE SUMMARY NOVEMBER, 1969

DECEMBER 15, 1969

PREPARED BY APOLLO SYSTEMS ENGINEERING

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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1.0 INTRODUCTION

This report presents current status of the weight and performance of Apollo space vehicles. The report contains selected monthly data which supplement those presented in the Quarterly Weight and Performance Report (U) SE 015-002-1.

Section 2.0 is devoted to the H Missions. It presents the weight and performance status of Apollos 13 and 14.

Section 3.0 is devoted to the J-1 Mission. It presents the weight and performance status of Apollo 16.

Control weight and performance values and definitions used here are those contained in the Apollo Program Specification SE 005-001-1, Appendix 10.1.

Anticipated weight and performance changes are included for both the H and J Missions. These changes are based on engineering estimates of pending changes not incorporated in the reported weights.

2.0 H MISSIONS

2.1 SUMMARY

The anticipated payload capability of the Saturn V launch vehicle SA-508 is 103,382 pounds. The actual payload capability will be determined when the operational trajectory is completed.

The CSM 109/LM-7 and CSM 110/LM-8 spacecraft weight changes have been divided into three types: those reported in MSC's monthly formal report, those reported in MSC's weekly internal reports since the last monthly report, and those which are anticipated. The inert weight changes from October to November are increases of approximately 14 and 6 pounds for CSM 109/LM-7 and CSM 110/LM-8 respectively. The weekly reported inert weight changes through November 21, 1969 show approximately no change for CSM 109/LM-7 and a 27-pound increase for CSM 110/LM-8. The changes for both of these categories are due principally to improved weight data, GFE and stowage changes, and miscellaneous changes for both the CM and LM.

The anticipated inert weight changes are increases of approximately 124 and 146 pounds for CSM 109/LM-7 and CSM 110/LM-8 respectively. These changes are due chiefly to (1) the possible addition of the food cold storage and warming capability to the CM and (2) GFE and stowage changes on the LM.

The current (November 1, 1969) total spacecraft injected weights (with propellants loaded to the delta-V requirement) for CSM 109/LM-7 and CSM 110/LM-8 are 97,872 and 98,141 pounds respectively. The corresponding values for full propellant tanks are 100,992 and 101,073 pounds. The inert weights for CSM 109 and CSM 110 are 23,434 and 23,452. The SLA weights associated with CSM 109 and CSM 110 are 4,045 and 4,042 pounds. The total injected LM-7 and LM-8 weights are 31,901 and 32,129 pounds with propellants loaded to the ΔV requirements, and 33,340 and 33,399 pounds with full propellant tanks.

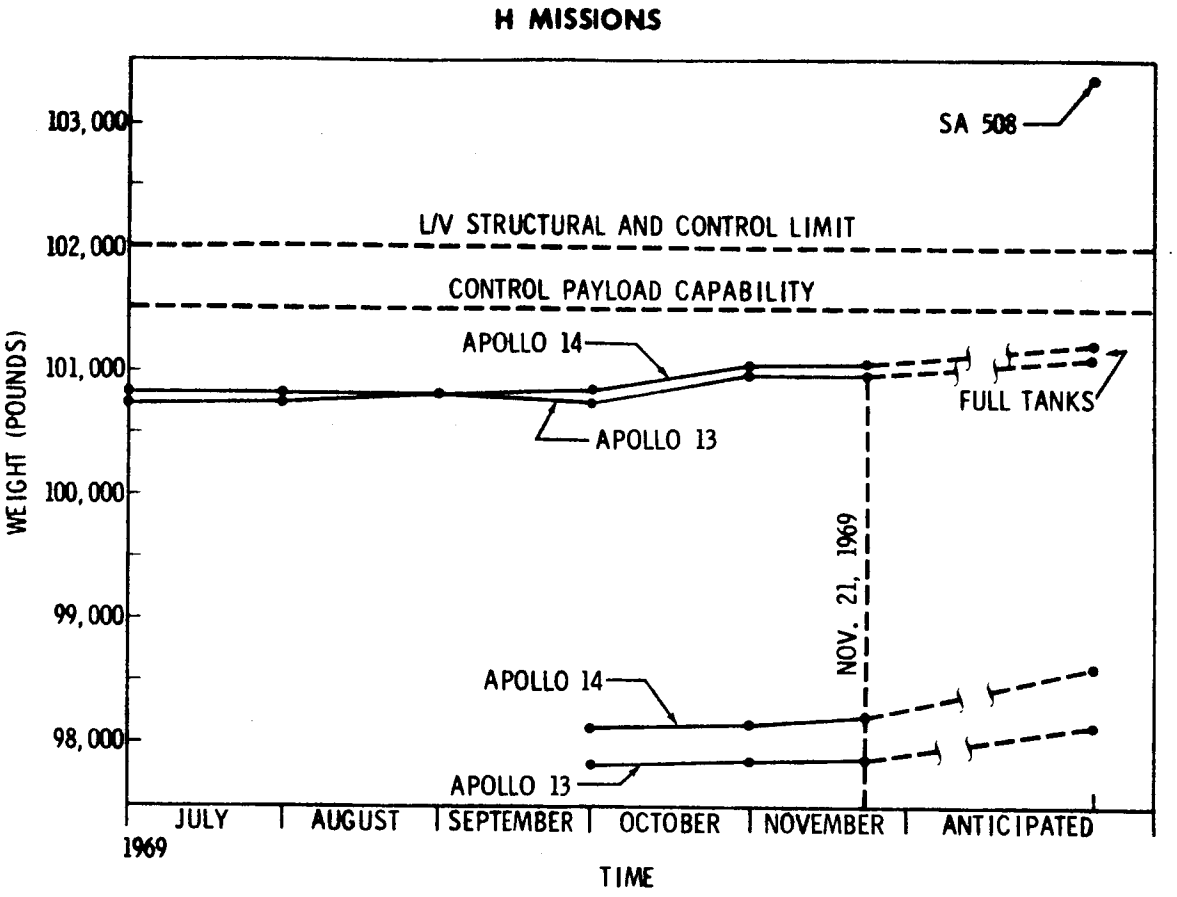
The delta velocities and I_{sp}'s used to obtain the propellant quantities for LM and CSM are listed below. All values apply to both CSM 109/LM-7 and CSM 110/LM-8 except where indicated otherwise.

	SM	LM ASCENT	LM DESCENT
ΔV (Nominal)	3470 fps (with LM) 3870 fps (Less LM)	6095 fps	6090 fps
I_{sp} (Nominal)	313.3 sec (SM 109) (Note 1) 313.8 sec (SM 110) (Note 1)	308.97 sec (Note 2) Integrated Average	301.25 sec (Note 2)

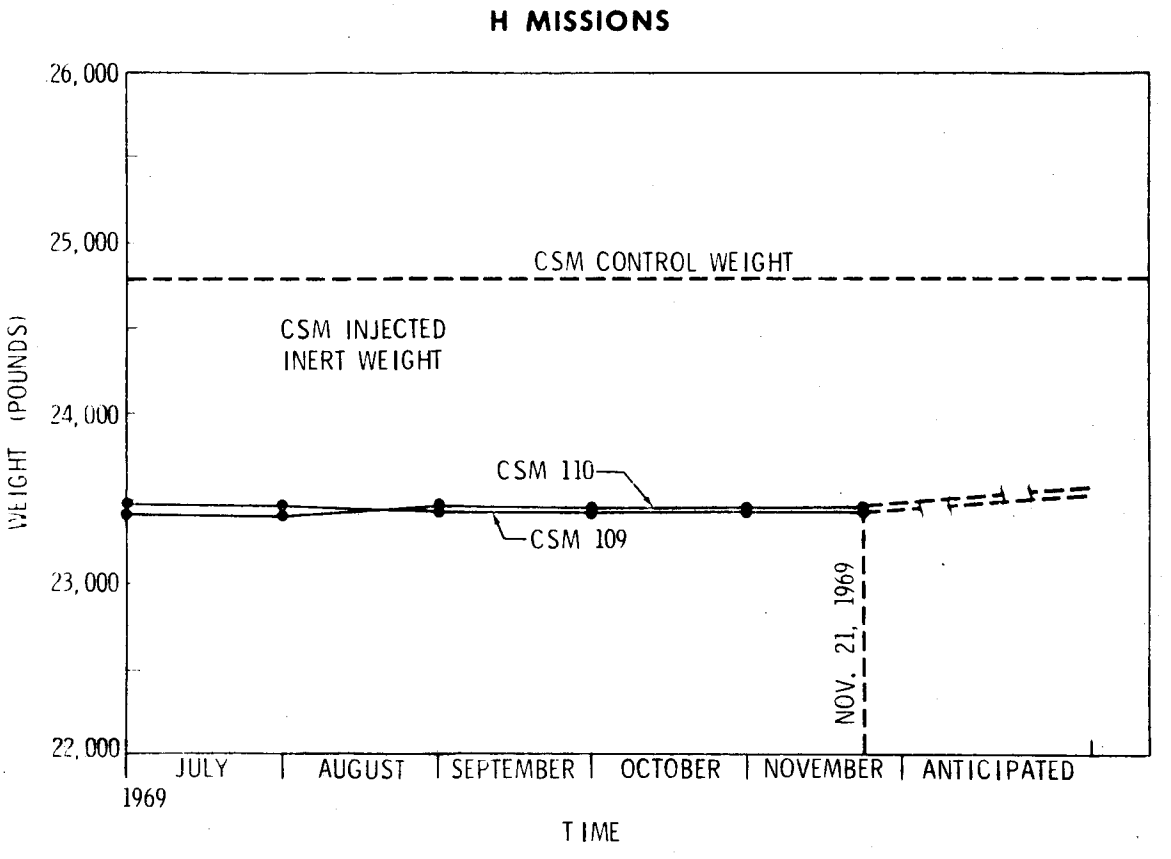
Note 1: Preliminary test data values

Note 2: Class data values

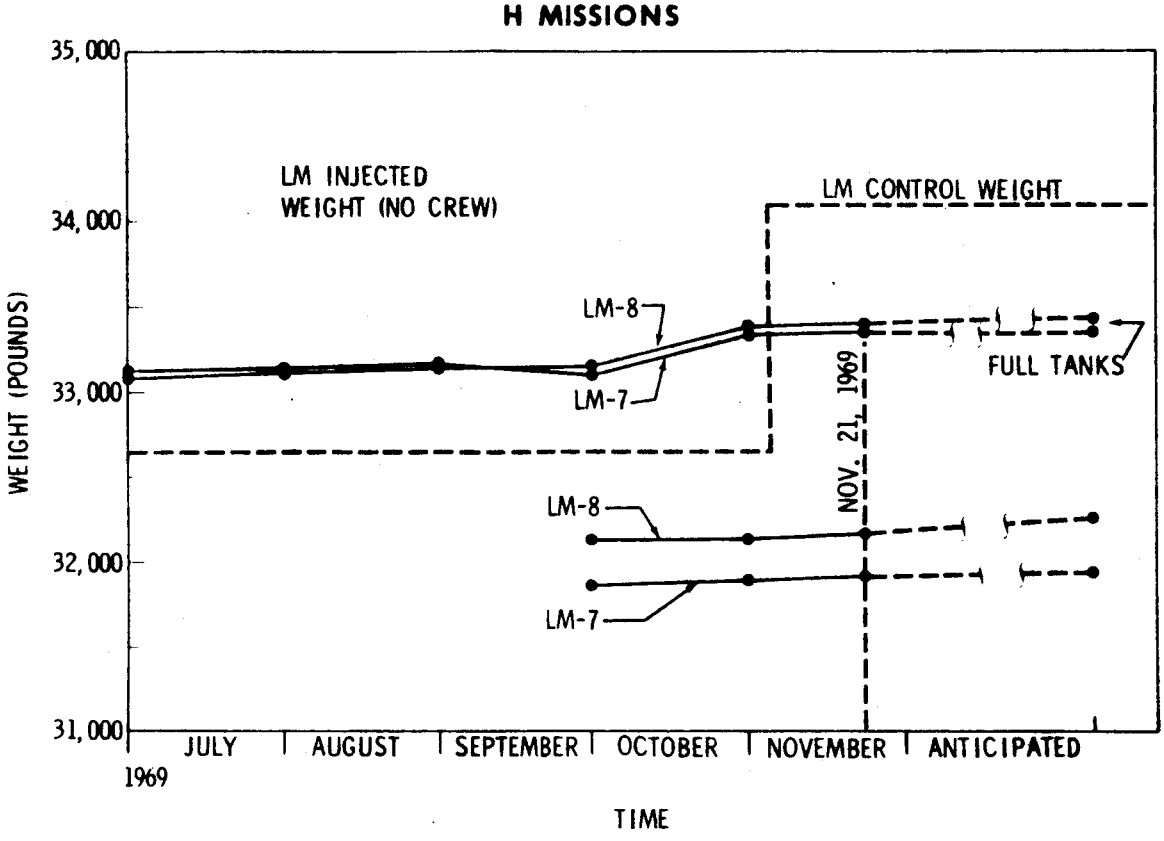
2.1.1. PAYLOAD MARGIN HISTORY



2.1.2. CSM WEIGHT HISTORY



2.1.3. LM WEIGHT HISTORY



2.2 WEIGHT/PERFORMANCE CHANGES

2.2.1. CSM CHANGES
(October 1969 to November 1969)

H MISSIONS

CHANGES	STAGE	APOLLO 13 CSM 109	APOLLO 14 CSM 110
		INERT WEIGHT (LBS)	INERT WEIGHT (LBS)
INCORPORATED IN MSC NOV. 1 MONTHLY REPORT			
IMPROVED WEIGHT DATA	CM SM	− 0.6 + 0.2	+ 0.2 + 0.6
GFE/STOWAGE	CM	+ 8.0	——
MISCELLANEOUS	CM SM	− 0.6 − 0.5	+ 0.8 ——
TOTAL	CM SM	+ 6.8 − 0.3	+ 1.0 + 0.6
INCORPORATED IN MSC INTERNAL REPORTS THROUGH NOV. 21			
IMPROVED WEIGHT DATA	CM	+ 1.1	+ 4.0
GFE/STOWAGE	CM	− 4.0	+ 10.0
MISCELLANEOUS	CM SM	− 1.9 + 2.3	+ 2.0 ——
TOTAL	CM SM	− 4.8 + 2.3	+ 16.0 ——
ANTICIPATED			
ADD FOOD STORAGE AND WARMING CAPABILITY	CM	+110.0	+110.0
TOTAL	CM	+110.0	+110.0

2.2.2 LM CHANGES
(October 1969 to November 1969)

H MISSIONS

CHANGES	STAGE	APOLLO 13 LM-7 INERT WEIGHT (LBS)	APOLLO 14 LM-8 INERT WEIGHT (LBS)
INCORPORATED IN MSC NOV. 1 MONTHLY REPORT			
IMPROVED WEIGHT DATA	ASC.	—	− 3.5
	DES.	−5.7	− 4.1
GFE/STOWAGE	ASC.	+ 8.8	+ 8.8
MISCELLANEOUS	ASC.	−2.4	− 0.5
	DES.	+ 6.6	+ 2.6
TOTAL	ASC.	+ 6.4	+ 4.8
	DES.	+ 0.9	− 1.5
INCORPORATED IN MSC INTERNAL REPORTS THROUGH NOV. 21			
IMPROVED WEIGHT DATA	ASC.	+ 2.8	+ 2.9
MISCELLANEOUS	ASC.	− 0.5	+ 0.7
	DES.	—	+ 7.3
TOTAL	ASC.	+ 2.3	+ 3.6
	DES.		+ 7.3
ANTICIPATED			
GFE/STOWAGE	ASC.	—	+ 1.4
	DES.	+12.6	+ 45.0
MISCELLANEOUS	ASC.	− 1.3	− 2.0
	DES.	—	—
TOTAL	ASC.	− 1.3	− 0.6
	DES.	+12.6	+ 45.0

2.3 LAUNCH VEHICLE PAYLOAD STATUS

MISSION AND LAUNCH VEHICLE	CONTROL PAYLOAD (LBS.)	CURRENT PAYLOAD CAPABILITY (11/69) (LBS.)	CHANGE IN PAYLOAD SINCE OCTOBER 1969 (LBS.)	PAYLOAD MARGIN (LBS.)
APOLLO 13				
SA 508	101,500	103,382	——	+1882

2.4 SPACECRAFT WEIGHT STATUS

MISSION AND SPACECRAFT MODULE	CONTROL WEIGHT (LBS.)	CURRENT WEIGHT (11/69) (LBS)	CHANGE IN WEIGHT SINCE OCTOBER 1969 (LBS.)	CONTROL WEIGHT MARGIN (LBS.)
APOLLO 13				
LM-7 ASCENT	5,520	5,287	+7	+233
LM-7 DESCENT	4,900	4,782	+1	+118
CM109	13,000	12,476	+7	+524
SM109	11,800	10,958	0	+842
ADAPTER	4,150	4,045	0	+105
APOLLO 14				
LM-8 ASCENT	5,520	5,349	+5	+171
LM-8 DESCENT	4,900	4,779	−2	+121
CM110	13,000	12474	+1	+526
SM 110	11,800	10,978	+1	+822
ADAPTER	4,150	4,032	0	+118

3.0 J-1 MISSION

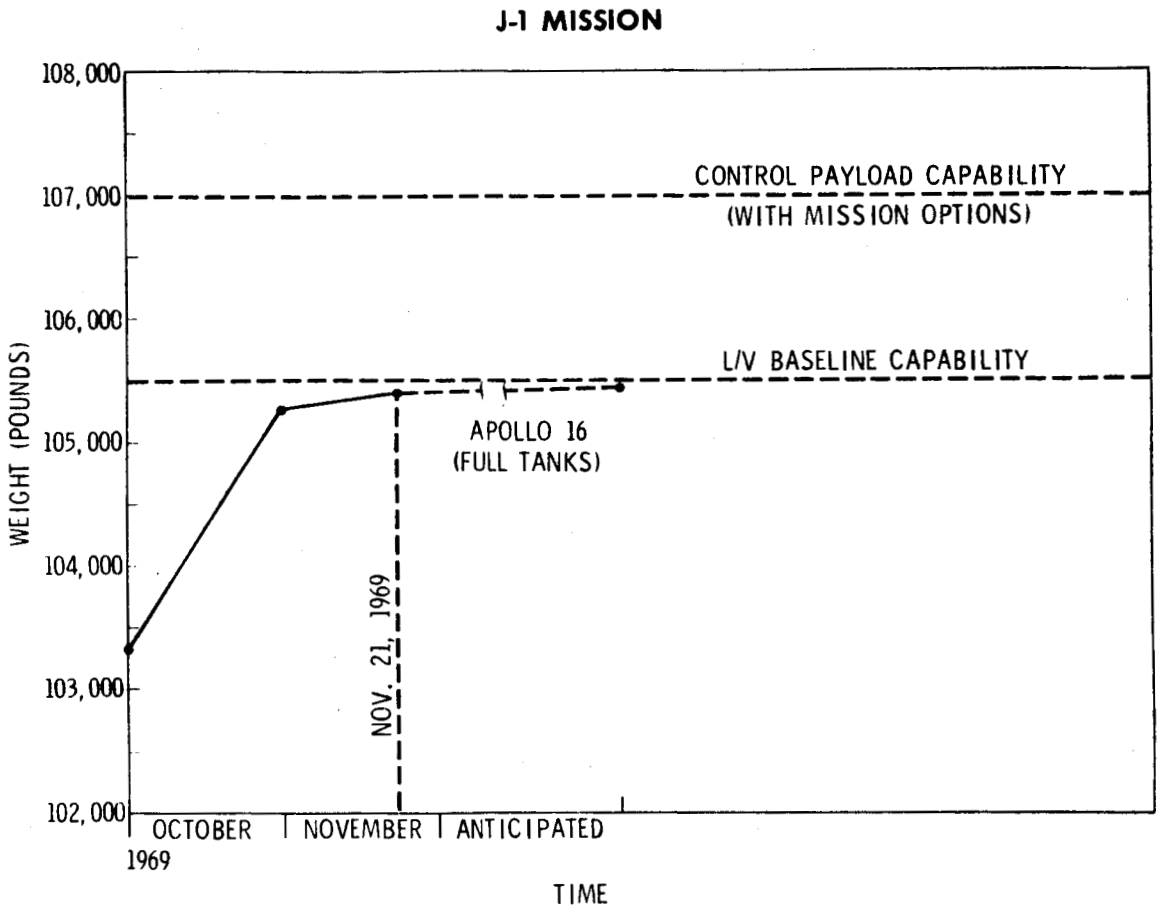
3.1 SUMMARY

The CSM 112/LM-10 spacecraft weight changes have been divided into three types, as described in Section 2.1. The inert weight change from October to November is an increase of approximately 2,865 pounds for CSM 112/LM-10. Most of this is due to inclusion of the ALEM and LMMP modifications. The remaining changes are principally due to the addition of a LM plume deflector, GFE/stowage changes on the CM and LM, improved weight data on the SM and LM, and a reduction in ballast on the CM. The weekly reported weight changes through November 1, 1969 show an increase in spacecraft inert weight of approximately 125 pounds. These changes result chiefly from CM and LM improved weight data, and CSM ALEM and LM LMMP modifications.

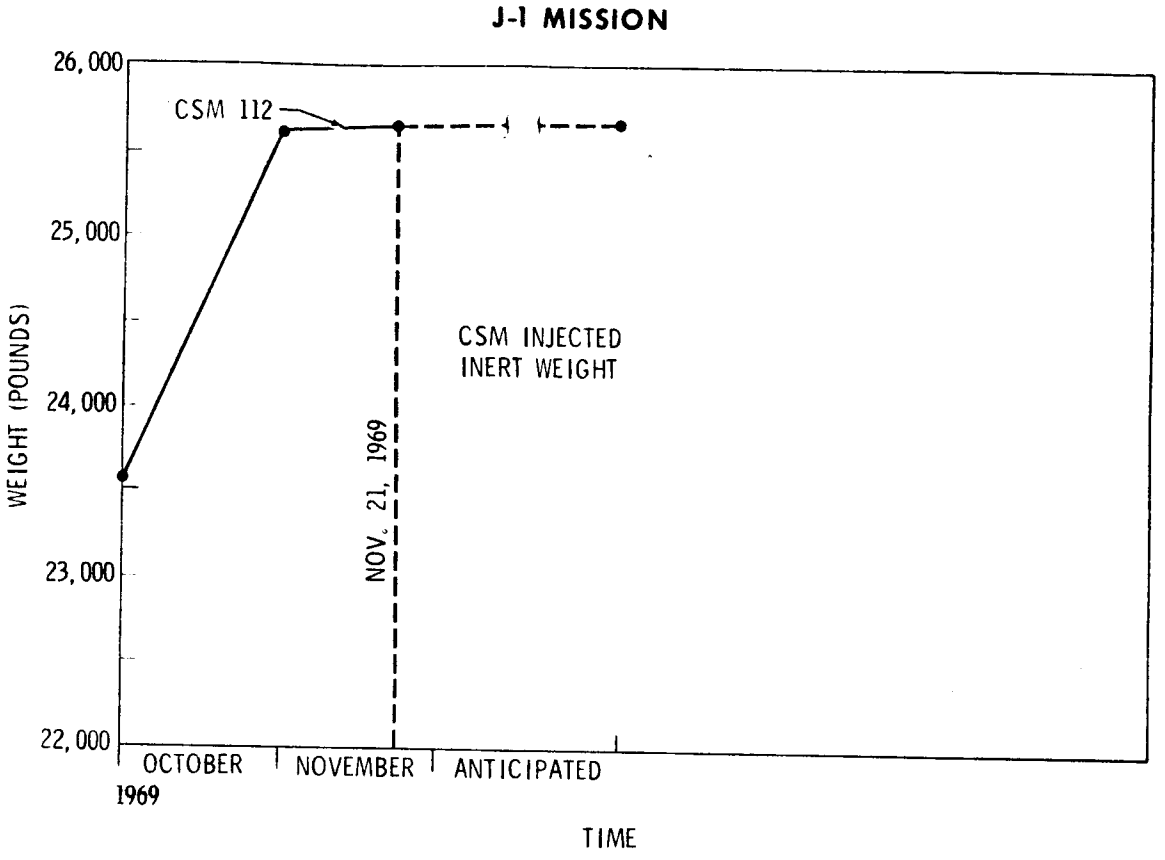
The anticipated CSM 112/LM-10 inert weight change is an increase of 30 pounds which is due to the possible addition of the mobile Equipment Transfer System (METS) on the LM.

The current (November 1, 1969) total spacecraft weight for CSM 112/LM-10 with full propellant tanks is 105,291 pounds. The CSM delta-V requirement for this mission has not been established. The CSM and SLA inert weight are 25,625 and 4,037 pounds respectively. The total LM injected weight is 33,905 pounds with propellants loaded to the ΔV reauirement, and 35,456 pounds with full propellant tanks.

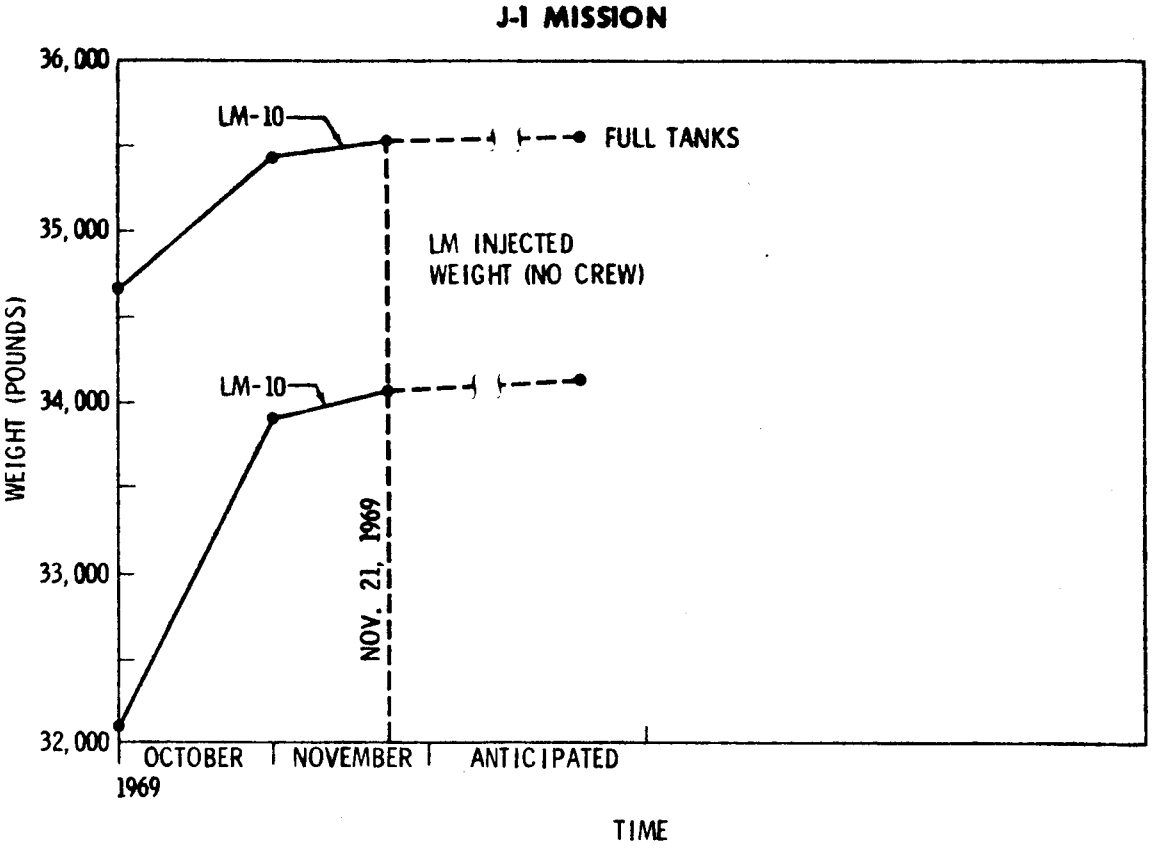
3.1.1. PAYLOAD MARGIN HISTORY



3.1.2. CSM WEIGHT HISTORY



3.1.3. LM WEIGHT HISTORY



3.2. WEIGHT/PERFORMANCE CHANGES

3.2.1 CSM CHANGES
(October 1969 to November 1969)

J-1 MISSION

CHANGES	STAGE	APOLLO 16 CSM 12 INERT WEIGHT (LBS)
INCORPORATED IN MSC NOV. 1 MONTHLY REPORT		
IMPROVED WEIGHT DATA	CM SM	+ 0.3 − 100.0
ALEM MODS	CM SM	+ 291.0 +1957.1
GFE/STOWAGE	CM	− 10.0
BALLAST	CM	− 77.0
MISCELLANEOUS	CM	+ 0.8
TOTAL	CM SM	+ 205.1 +1857.1
INCORPORATED IN MSC INTERNAL REPORTS THROUGH NOV. 21		
IMPROVED WEIGHT DATA	CM	+ 4.0
GFE/STOWAGE	CM	+ 1.0
ALEM MODS	CM SM	− 3.7 + 55.7
MISCELLANEOUS	CM	+ 2.0
TOTAL	CM SM	+ 3.3 + 55.7
ANTICIPATED	—	—

3.2.2. LM CHANGES
(October 1969 to November 1969)

J-1 MISSION

CHANGES	STAGE	APOLLO 16 LM-10 INERT WEIGHT (LBS)
INCORPORATED IN MSC NOV. 1 MONTHLY REPORT		
IMPROVED WEIGHT DATA	ASC. DES.	—— − 29.4
PLUME DEFLECTOR	DES.	+ 42.5
GFE/STOWAGE	ASC.	+ 7.9
LMMP MODS	ASC. DES.	+ 84.2 + 690.6
MISCELLANEOUS	ASC. DES.	+ 0.1 + 7.1
TOTAL	ASC. DES.	+ 92.2 + 710.8
INCORPORATED IN MSC INTERNAL REPORTS THROUGH NOV. 21		
IMPROVED WEIGHT DATA	ASC. DES.	+ 7.2 − 29.3
LMMP MODS	ASC. DES.	+ 9.3 + 65.6
MISCELLANEOUS	ASC. DES.	+ 0.6 + 12.4
TOTAL	ASC. DES.	+ 17.1 + 48.7
ANTICIPATED		
MOBILE EQUIPMENT TRANSFER SYSTEM (METS)	DES.	+ 30.0
TOTAL	DES.	+ 30.0

3.3 SPACECRAFT WEIGHT STATUS

MISSION AND SPACECRAFT MODULE	CONTROL WEIGHT (LBS.)	CURRENT WEIGHT (11/69) (LBS.)	CHANGE IN WEIGHT SINCE OCTOBER 1969 (LBS.)	CONTROL WEIGHT MARGIN (LBS.)
APOLLO 16				
LM-10 ASCENT	UNDER	5,418	92	
LM-10 DESCENT		5,490	711	
CM112	STUDY	12,676	205	
SM112		12,979	1,857	
ADAPTER		4,037	0	